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Research Article

SEASONAL AND DIVERSITY ASSESSMENT OF PLANKTONIC COMMUNITY OF BETWA RIVER IN BUNDELKHAND REGION

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ABSTRACT

In the present investigation, total eighteen phytoplanktonic varieties under the four algal groups (Chlorophyceae, Myxophyceae, Bacillariophyceae and Euglenophyceae) while a total of twenty zooplanktonic microorganisms under the four groups (Protozoans, Rotiferens, Cladocerans and Copepods) were recorded. For the qualitative, quantitative as well as their seasonal analysis of planktonic community, water samples were collected from four different sites located on Betwa river during the entire study period from July 2017 to June 2019. After the analysis, 9 members of Chlorophycean group, 5 members of Myxophyceae group, 3 members of Bacillariophyceae group and only single member of Euglenophyceae group were found under the phytoplanktonic category, in which Chlorophyceae group was occupied maximum contribution of 52.32%, while second largest contribution 25.11% occupied by Myxophyceae group and percentage composition of Bacillariophyceae and Euglenophyceae group was 17.58% and 4.97% respectively while under the zooplanktonic category 4 members of Protozoan, 5 members each of Rotifers and Copepods, 6 members of Cladocerans were observed, in which Rotiferans was occupied maximum contribution of 35.02% and group Protozoans was contributed least percentage composition of only 12.75%. The zooplanktonic *Brachionus sp*. was mostly present in the entire research area at every sampling station while availability of other zooplanktonic fauna were fluctuated in other sampling stations. The seasonal abundance of plankton were reached maximum in the summer season, intermediate during winter and minimum in the rainy period.

Keywords: *Planktonic community, Betwa river, Bundelkhand region*

INTRODUCTION

Among planktons, phytoplanktons are chlorophyll bearing autotrophic primary producer organisms who are the representative members at the lowest level in the food chain pyramids of an aquatic ecosystem. They regulate the food chain, maintain biomass productivity and release molecular oxygen through photosynthesis. Phytoplankton constitute the major source of energy in the food web of any ecosystem and are regarded as biological wealth of water for fishes and constitute a vital link in the food chain (Wetzel, 2001). The actual picture of productivity for any aquatic system may be judged by phytoplankton biomass (Shukla and Shukla, 2013). The zooplanktons act as an important linker organism for transformation of energy in aquatic food web because of their drifting nature, large density, high species diversity and tolerance to the stress conditions (Bhat *et al.*, 2014). These are the main sources of natural food for fish which is directly related to their survival and growth and are the base of food chains and food webs in all aquatic ecosystems (Miah *et al.*, 2013). Zooplankton communities respond to a wide variety of

disturbances including nutrient loading, acidification, and sediment input etc. It is a well-suited tool for understanding water pollution status (Contreras *et al.,* 2009). These biotic communities play an important role in the production process as well as maintain a biological equilibrium in the aquatic ecosystem.

MATERIALS AND METHODS

Study Area- The entire research area, where this study was conducted is divided into the four sampling sites, 1- Noutghat 2- Kolwan 3-Baratha village 4- Parichha dam head located along the bank of Betwa river. These all sampling stations are located in Jhansi district.

Sample Collection and Preservation- During the morning hours, water samples were collected from all the sampling sites by filtering the desirable amount of water through plankton net of bolting silk cloth, number 25 with mesh size of 65µm. It is a cone shaped net whose upper broder circumference remains attached to a metallic ring with handle and the lower narrow circumference is fixed to the mouth of a collecting sampler tube. The collected samples were fixed carefully by adding 4% of formalin solution/lugol iodine solution and preserved it for about 24 hours for better sedimentation. On the next day, supernatant was removed carefully and concentrated residue was now examined with the use of Sedgwick Rafter cell counting chamber method.

Qualitative and Quantitative Analytical Technique- The Sedgwick Rafter Cell is a special type of slide which is in the form of a rectangular plate with a cavity and 50mm×20mm×10mm dimension that holds 1 ml of sample. On moving this cell in a horizontal direction on the stage of microscope, quantitative enumeration of planktonic species was carried out. While the qualitative identification of phytoplankton and zooplankton were carried out by the keys and standard procedure prescribed by several workers (Adoni, 1985; Dang *et al.,* 2015; Edmondson, 1959; Needham and Needham, 1941; Palmer, 1980; Prescott, 1954; Sehgal, 1983).

RESULTS AND DISCUSSION

During the study period from river Betwa, total eighteen phytoplanktonic microorganisms were observed which classified under the four groups namely Chlorophyceae, Myxophyceae, Bacillariophyceae and Euglenophyceae. The Chlorophycean group includes nine phytoplanktonic members (*Cladophora, Coelastrum, Closterium, Pandorina, Spirogyra, Staurastrum, Ulothrix, Volvox* and *Zygnema sp*.), group Myxophyceae include five phytoplanktonic members (*Anabaena, Anasystis, Oscillatoria, Phormidium* and *Rivularia).*,group Bacilliriophyceae includes three phytoplanktonic members (*Diatom, Pinnularia* and *Synedra sp.*) while the group Euglenophyceae include only single member of *Euglena sp.*. Among all the observed phytoplanktonic faunal population from the research area group Chlorophyceae was occupied maximum contribution of 52.32%, second largest contribution of 25.11% occupied by the Myxophyceae group followed by occupied percentage contribution of Bacillariophyceae was 17.58% and group Euglenophyceae was least percentage composition of only 4.97%. Hence the trend of quantitative abundance of the phytoplanktonic community was recorded in the following manner: Chlorophyceae>Myxophyceae Bacillariophyceae>Euglenophyceae. This observation was similar to the result supported earlier

by Sharma *et al.*, (2011) studied in Pichola Lake in Rajasthan, , Kumar and Khare (2015) in Yamuna river of Kalpi at Jalaun district, Kumar and Singh (2015) in Angoori Reservoir of Madhya Pradesh.

A total of twenty varieties of zooplanktonic microorganisms were also recorded under the four groups like Protozoans, Rotiferens, Cladocerans and Copepods. In which protozoan group represented by four zooplanktonic varieties include *Arcella, Actinophrys, Difflugia* and *Vorticella*, group Rotifera represents five zooplanktonic varieties includes *Asplanchna, Brachionus, Cephalodella*, *Keretella* and *Monostyla.* Among the Cladocerans, six zooplanktonic varieties includes *Bosmina, Ceriodaphnia, Daphnia, Diaphanosoma, Moina* and *Simocephalus* were recorded group, while Copepods group represented by five zooplanktonic varieties includes *Acanthocyclops, Cyclops*, *Diaptomus, Macrocyclops* and *Mesocyclops*. Among all the recorded zooplanktonic faunal varieties from the research area group Rotiferans was occupied maximum contribution of 35.02%, while second largest contribution 30.91% occupied by Cladoceran group, while occupied percentage composition of Copepods was 21.30% and group Protozoans was contributed least percentage composition of only 12.75% of zooplanktonic fauna.

Thus the trend of quantitative abundance of the zooplanktonic community was recorded as in the following manner: Rotifers>Cladocerans>Copepods>Protozoans. The supremacy of Rotifera among all the zooplanktonic groups was also observed by Kar and Kar (2016) who worked on diversity of zooplankton in freshwater Lake of Assam, concluded populated dominance of Rotiferans is very important for fish productivity and suitable for aquaculture. Goswami *et al.*, (2017) also reported Rotifera group constituted 70% dominancy and distribution among all the observed zooplanktonic population in various urban ponds in Kolkata. Manickam et al., (2018) carried out study of seasonal biodiversity of zooplanktons in Ukkadam Lake in Tamilnadu, also reported predominant abundance of Rotifera followed by Cladocera, Copepods and Ostracoda.

There were many fluctuating differences were also observed for analyzing the seasonal variation of planktonic organisms because different varieties of planktons were dominant at different seasons. During the summer season, maximum availability of phytoplanktonic and zooplanktonic population of a total of fourteen and fifteen varieties were observed respectively in this season. In the winter season, intermediate availability of phytoplankton and zooplanktons population of a total eleven generic varieties of each were observed while during the monsoon season, lowest availability of phytoplanktonic and zooplanktonic population of only eight and six generic varieties were observed respectively. Phytoplanktonic varieties like *Pandorina, Ulothrix* and *Anabaena* were observed in all the seasons, while zooplanktonic varieties like *Brachionus, Bosmina* and *Moina* were also recorded in all the seasons. The maximum prevalence of planktonic availability during the summer period was may be due to during this time, temperature and alkalinity was high which accelerates the rate of decomposition of organic matter and ultimately favor an increase concentration or availability of organically enriched food nutrients level in the water body for planktons. The lowest populated density of phytoplanktons observed during the rainy season was due to increased wavy action of water current, high turbidity mode and increased dilution efficiency of nutrients. Thus, the following trends of seasonal variation of planktonic organisms were noticed, Summer>Winter>Rainy. Our findings were similar to those as recorded earlier by Kumar *et al.*, (2011) in Varsada wetland, Sharma and Singh (2012) in Tighra reservoir, Tiwari (2015) in Pariyat river and Tyagi and Malik (2017) in RamGanga reservoir.

Table: 1 Quantitative Analysis of Phytoplankton (ul^{-1}) from July 2017 to June 2019 different sampling Stations

Group	Name of Phytoplanktons	2017-18				2018-19						
		A	B	C	D	A	B	C	D	Total	Range	Mean± SD
Chloro-phyceae	*Cladophora sp.*	×	23	30	×	×	26	24	×	103	23-30	12.8±13.9
	Coelastrum sp.	20	×	×	23	28	×	×	25	96	20-28	12.0±13.0
	Closterium sp.	25	×	×	20	35	×	×	22	102	20-35	12.7±14.3
	Pandorina sp.	×	×	34	30	×	×	26	28	118	26-34	14.7±15.9
	Spirogyra sp.	32	×	26	29	23	×	20	16	146	16-32	18.2±12.3
	Staurastrum sp.	17	×	×	20	24	×	×	19	80	17-24	10.0±10.8
	Ulothrix sp.	×	29	22	×	×	31	24	×	106	22-31	13.2±14.4
	Volvox sp.	30	×	27	24	18	×	29	20	148	18-30	18.5±12.1
	Zygnema sp.	×	×	20	31	×	×	22	28	101	20-31	12.6±13.9
	Total sp.	**124**	**52**	**159**	**177**	**128**	**57**	**145**	**158**	**1000**	**52-177**	**125±46.7**
Myxophy-ceae	*Anabaena sp.*	24	×	×	26	31	×	×	36	117	24-36	14.6± 16.0
	Anacystis sp.	17	×	×	23	20	×	×	25	85	17-25	10.6±11.5
	Oscillatoria sp.	19	15	×	24	21	25	×	16	120	16-25	15.0± 9.8
	Phormidium sp.	×	×	×	29	×	×	×	34	63	29-34	7.8±14.6
	Rivularia sp.	30	×	×	18	27	×	×	20	95	18-30	11.8±13.2
	Total sp.	**90**	**15**	**×**	**120**	**99**	**25**	**×**	**131**	**480**	**15-131**	**60.0±55.4**
Bacillirio-phyceae	*Diatom sp.*	×	29	25	×	×	31	26	×	111	25-31	13.8± 14.9
	Pinnularia sp.	×	26	24	×	×	22	32	×	104	22-32	13.0±14.1
	Synedra sp.	23	×	32	×	26	×	40	×	121	23-40	15.1±16.8
	Total sp.	**23**	**55**	**81**	**×**	**26**	**53**	**98**	**×**	**336**	**23-98**	**42.0±36.0**
Eugleno-phyceae	*Euglena sp.*	21	×	×	20	26	×	×	28	95	20-28	11.8±12.9
	Total sp.	**21**	**×**	**×**	**20**	**26**	**×**	**×**	**28**	**95**	**20-28**	**11.8±12.9**

Note: Absent (×)

Table: 2 Quantitative Analysis of Zooplankton (ul^{-1}) from July 2017 to June 2019 for different sampling Stations

	Name of Zooplanktons	2017-18				2018-19						
		A	B	C	D	A	B	C	D	Total	Range	Mean± SD
Proto-zoans	*Arcella sp.*	×	22	×	26	×	12	×	13	73	12-26	9.1± 10.7
	Actinophrys sp.	18	×	15	×	20	×	29	×	82	15-29	10.2±11.6
	Diffuzia sp.	20	16	×	×	14	12	×	×	62	12-20	7.7± 8.5
	Voticella sp.	15	×	×	12	18	×	×	14	59	12-18	7.3± 8.0
	Total sp.	**53**	**38**	**15**	**38**	**52**	**24**	**29**	**27**	**276**	**15-53**	**34.5±13.3**
Rotife-rans	*Asplanchna sp.*	28	×	×	35	21	×	×	29	113	21-35	14.1± 15.5
	Branchionus sp.	35	26	14	28	45	20	18	36	222	14-45	27.7±10.4
	Cephalodella sp.	22	×	×	34	30	×	×	42	128	22-42	16.0± 17.9
	Keretella sp.	33	×	×	48	54	×	×	35	170	33-54	21.2±23.6
	Monostyla sp.	25	×	×	32	40	×	×	28	125	25-40	15.6±17.2
	Total sp.	**143**	**26**	**14**	**177**	**190**	**20**	**18**	**170**	**758**	**14-190**	**94.7±81.5**
Clado-cerans	*Bosmina sp.*	18	32	25	×	12	26	16	×	129	12-32	16.1± 11.7
	Ceriodaphnia sp.	15	24	16	×	28	20	10	×	113	10-28	14.1±10.3
	Daphnia sp.	×	35	28	×	×	42	30	×	135	28-42	16.8± 18.4
	Diaphanosoma sp.	28	20	×	×	30	23	×	×	101	20-30	12.6±13.8
	Moina sp.	×	25	23	×	×	27	32	×	107	23-32	13.3±14.5
	Simocephalus sp.	×	18	21	×	×	25	20	×	84	18-25	10.5±11.3
	Total sp.	**61**	**154**	**113**	×	**70**	**163**	**108**	**×**	**669**	**61-163**	**83.6±62.5**
Cope-podes	*Acanthocyclops sp.*	18	×	20	26	30	×	28	34	156	18-34	19.5±13.0
	Cyclops sp.	×	25	27	×	×	18	23	×	93	18-27	11.6±12.6
	Diaptomus sp.	×	18	×	22	×	15	×	14	69	14-22	8.6±9.5
	Macrocyclops sp.	×	24	×	×	×	29	×	×	53	24-29	6.6±12.3
	Mesocyclops sp.	×	28	15	×	×	20	27	×	90	15-28	11.2±12.6
	Total sp.	**18**	**95**	**62**	**48**	**30**	**82**	**78**	**48**	**461**	**18-95**	**57.6±26.5**

Note: Absent (×)

Table 3: Showing group wise total number of Phytoplanktons (ul^{-1}) of various sampling station from July 2017 to June 2019

S. No.	Group of Phytoplanktons	A	B	C	D	Total	Percentage composition
1	**Chlorophyceae**	252	109	304	335	1000	**= 52.32%**
2	**Myxophyceae**	189	40	×	251	480	**= 25.11%**
3	**Bacilliriophyceae**	49	108	179	×	336	**= 17.58%**
4	**Euglenophyceae**	48	×	×	48	95	**= 4.97%**
	Total Phytoplanktons (ul^{-1})	**538**	**257**	**483**	**634**	**1911**	

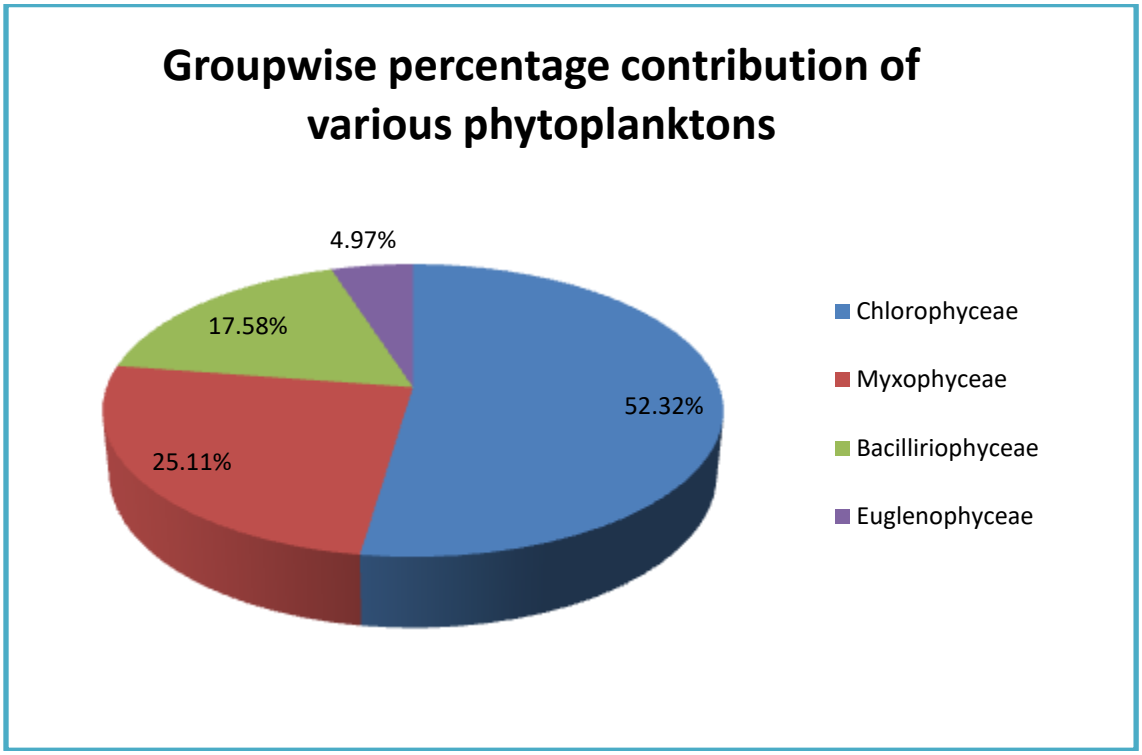


Table 4: Showing group wise total number of zooplanktons ($ul^{-1)}$ of various sampling station from July 2017 to June 2019.

S. No.	Zooplanktons	A	B	C	D	Total	Percentage composition
1	**Protozoa**	105	62	44	65	**276**	**= 12.75%**
2	**Rotifera,**	333	46	32	347	**758**	**= 35.02%**
3	**Cladocera**	131	317	221	×	**669**	**= 30.91%**
4	**Copepoda**	48	177	140	96	**461**	**= 21.30%**
	Total Zooplanktons (ul^{-1})	**617**	**602**	**437**	**508**	**2164**	

Note: *Absent (×).*

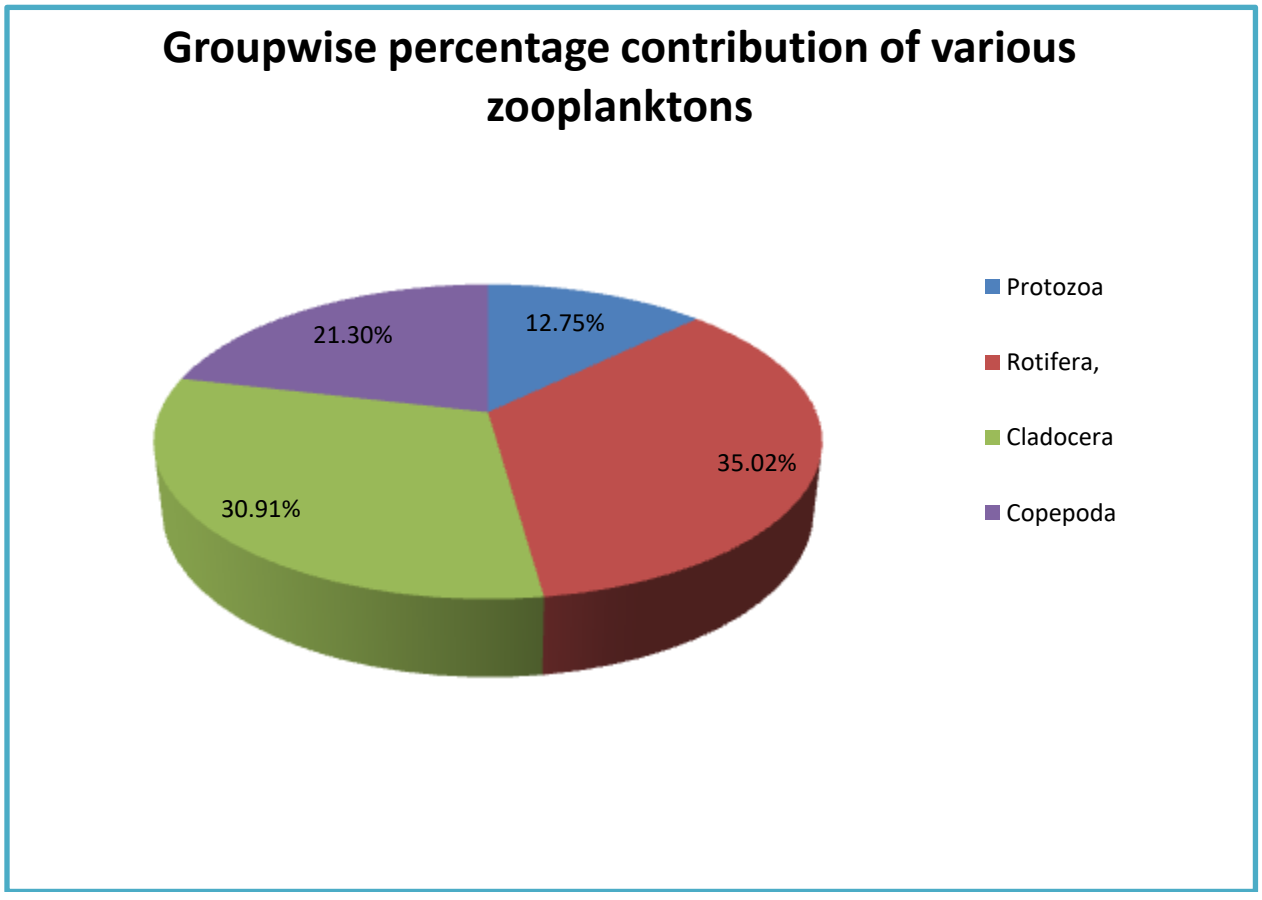


Table 5: Seasonal Variation of Phytoplankton from July 2017 to June 2019

S.No.	Name of Phytoplankton	Rainy	Winter	Summer
1	*Cladophora sp.*	√	√	×
2	*Coelastrum sp.*	×	√	√
3	*Closterium sp.*	×	×	√
4	*Pandorina sp.*	√	√	√
5	*Spirogyra sp.*	×	√	√
6	*Stauurastrum sp.*	×	×	√
7	*Ulothrix sp.*	√	√	√
8	*Volvox sp.*	√	×	×
9	*Zygnema sp.*	×	√	√
10	*Anabaena sp.*	√	√	√
11	*Anacystis sp.*	×	×	√
12	*Oscillatoria sp.*	×	√	×
13	*Phormidium sp.*	√	×	√
14	*Rivularia sp.*	√	×	√
15	*Diatom sp.*	×	√	√
16	*Pinnularia sp.*	×	√	√
17	*Synedra sp.*	√	√	×
18	*Euglena sp.*	×	×	√
	Total Phytoplanktons	**8**	**11**	**14**

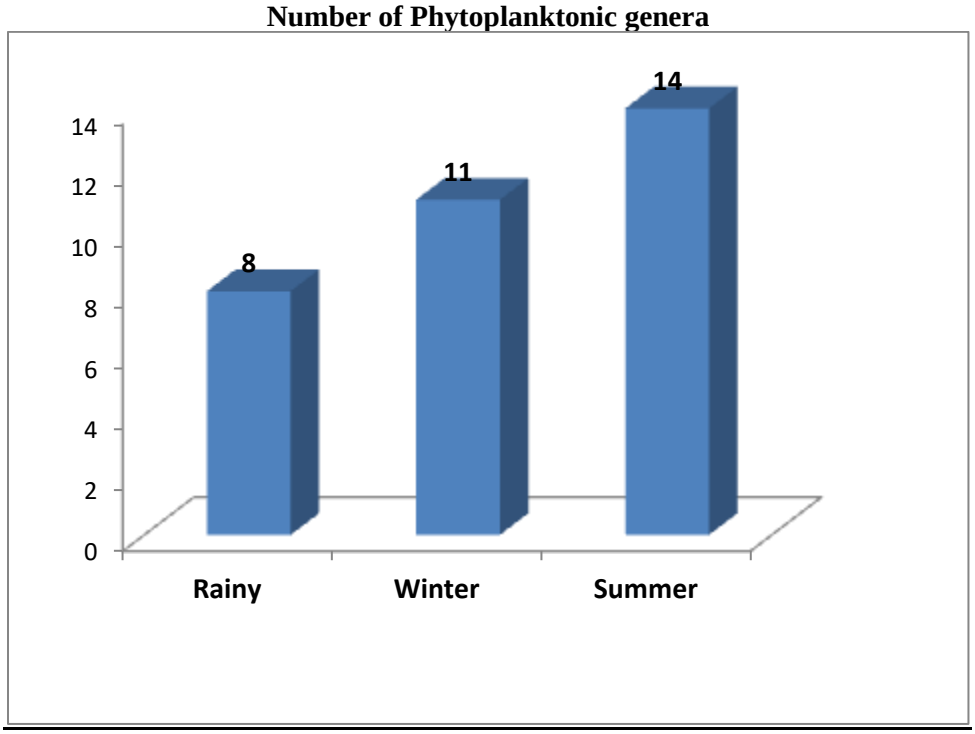
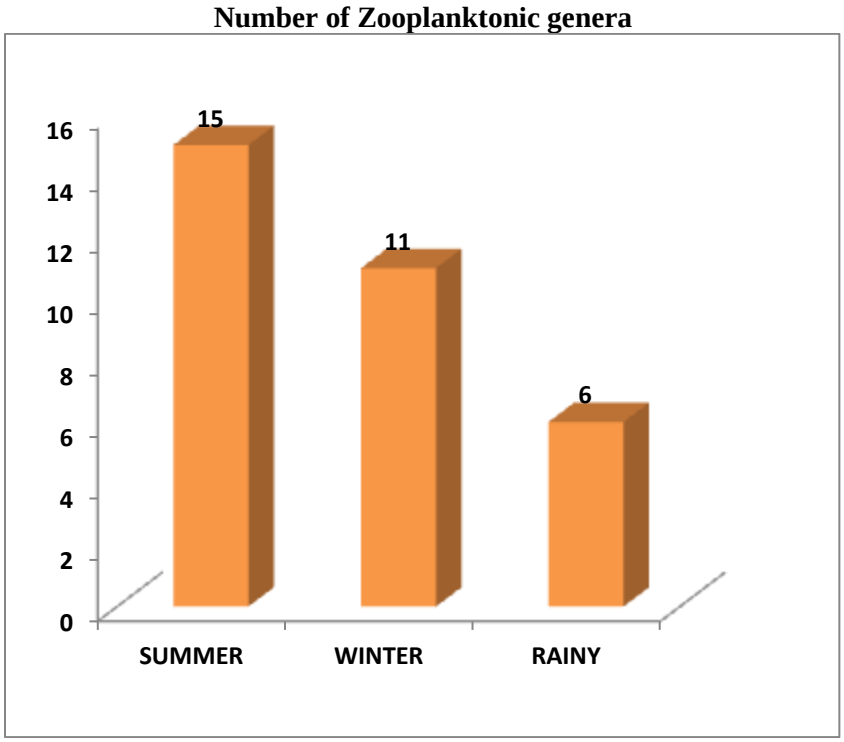


Table 6: Seasonal Variation of Zooplankton (ul^{-1}) from July 2017 to June 2019

S.No.	Name of Zooplanktons	Rainy	Winter	Summer
1	*Arcella sp.*	×	×	√
2	*Actinophrys sp.*	×	√	×
3	*Diffuzia sp.*	×	×	√
4	*Voticella sp.*	×	×	√
5	*Asplanchna sp.*	×	√	×
6	*Branchionus sp.*	√	√	√
7	*Cephalodella sp.*	×	×	√
8	*Keretella sp.*	×	√	√
9	*Monostyla sp.*	×	×	√
10	*Bosmina sp.*	√	√	√
11	*Ceriodaphnia sp.*	×	√	√
12	*Daphnia sp.*	×	×	√
13	*Diaphanosoma sp.*	×	√	×
14	*Moina sp.*	√	√	√
15	*Simocephalus sp.*	×	×	√
16	*Acanthocyclops sp.*	√	×	√
17	*Cyclops sp.*	√	√	×
18	*Diaptomus sp.*	×	√	×
19	*Macrocyclops sp.*	√	×	√
20	*Mesocyclops sp.*	×	√	√
Total no. Zooplanktonic genera		**06**	**11**	**15**

Note: *Present (√), Absent (×)*



CONCLUSION

The present work concluded that the selected study region of Betwa rivers support a much diversified planktonic and zooplanktonic community. Chlorophycea and Rotiferans were dominantly present in the Betwa river water. The presence of these biotic communities in the sufficient quantities is considered as an essential tool for the actual management of aquatic ecosystem. Their population is also act as an important and deciding positive sign for the measurement of productivity of water body. Rotifers are favourite natural food sources for piscian larvae. Hence they play a key role for maintaining the aquaculture measurement. The occurrence probability of planktonic species was recorded in peak range during the summer period while the least availability was observed in monsoon season which may be due to the diverse environmental, climatic and hydrobiological conditions for the particular water body, which are primarily responsible for their seasonal fluctuation trends in their quality as well as quantitative prevalence.

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